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The meetings of the American Association for the Advancement of Science, and of the Geological Society of America, which will take place during the week preceding that of the meeting of the congress, will be held in the same building. The daily programme of the several meetings is as follows.

Aug. 19 to 22. — Meetings of the various sections of the American Association for the Advancement of Science. The foreign members of the congress have been made honorary associate members of the association by its council, and are thereby entitled to take part in its geological and archaeological excursions in the vicinity of Washington, and to avail themselves of the reduced rates of fare on railroads which are accorded to its members. American members of the congress who are not already members of the association are invited to join it at the present meeting.

Aug. 24 and 25. — Meetings of the Geological Society of America. The foreign members of the congress are likewise invited to attend the meetings of this society, to contribute papers, and to take part in the present meeting.

Aug. 26 to Sept. 2. — Meetings of the International Congress of Geologists.

Besides the regular subjects of discussion, such as unfinished business of the former congress, reports of committees, etc., the Committee on Organization recommends that the following subjects be made special topics for the consideration of the congress at this meeting: (I) Time correlation of the clastic rocks; (1) correlation by structural data; (a) by stratigraphical data, (b) by lithological data, (c) by physiographical data; (2) correlation by paleontological data; (a) by fossil plants, (b) by fossil animals; or (a) by marine fossils, (b) by terrestrial fossils: (II) General geological color schemes and other graphic conventions: (III) Genetic classification of the pleistocene rocks.

The Committee of Organization has arranged with Thomas Cook & Son for reduced rates on certain lines of ocean steamships, for members coming from Europe. On all the principal railroads of the United States, members can obtain a reduction of one-third on regular rates from all main points to Washington and return, if they are members of the American Association for the Advancement of Science, or become so during the meeting. For this purpose it is only necessary in buying a ticket for Washington to obtain from the agent a receipt for the amount paid, on a particular form furnished him for this purpose. When the member leaves Washington, the presentation of this receipt, together with the membership card of the association, will entitle him to a return ticket over the same route for one-third the regular fare.

The long excursion will be made on special trains, carrying seventy-five persons, and fitted with all the latest appliances for the comfort of travellers. It will constitute a moving hotel, permitting free and safe passage from one end to the other at all times, and will take the party wherever the rails are laid in the regions visited, and stop wherever desired. As at present planned the excursion will occupy twenty-five days, and cost \$265 per person, which will cover every necessary expense. The route laid out covers thirty-eight degrees of latitude and twelve of longitude, and enables the traveler to see the finest scenery and most important geological phenomena of the Eastern States, the Mississippi Valley, and of the Rocky Mountain region, passing a week among the wonders of the Yellowstone Park.

The following shorter excursions are suggested, and American geologists familiar with the regions stand ready to conduct parties. If a sufficient number agree to go on these excursions, concessions may be obtained from the railroads to reduce the expenses to a minimum: (1) Through the Southern Appalachian regions, examining the peculiarly appressed folds in paleozoic rocks, and viewing the newly opened mines of coal, iron, manganese, tin, and gold; (2) to the copper and iron regions of Lake Superior, and the great developments of Pre-Cambrian or Algollian rocks; (3) through the coal and oil regions of Pennsylvania to Niagara Falls, down the St. Lawrence River to Montreal and Quebec, and return through the classic paleozoic and taconic regions of New York and Vermont.

Members who desire to examine particular localities or geological horizons are requested to correspond with the secretaries as early as possible, and all efforts will be made to arrange so that

their wishes may be complied with. Already a short excursion has been planned by Professor H. S. Williams for the week preceding the meeting of the geologists to see the typical development of paleozoic beds (especially Devonian) in the State of New York, in which a number of European geologists have already signified their desire to participate. Correspondence should be addressed to S. F. Emmons, 1330 F Street, Washington, D.C.

BACTERIA.

THE first of a series of lectures on the nature and functions of bacteria was recently delivered at the Royal Institution, London, by Dr. E. Klein, F.R.S. According to the *Lancet*, to which we are indebted for a brief report of the lecture, Dr. Klein said that perhaps in no branch of biological science had advances in the methods of research within the last twenty-five or thirty years been so enormous as in this subject. In 1828 Ehrenberg recognized the existence in water of minute mobile organisms, which he considered to belong to the group of animalculæ known as infusoria, an assumption which was now known to be erroneous. In 1837 Schwann demonstrated the presence in atmospheric air and in dust of living microscopic beings, which he showed by direct experiment to be endowed with the power of producing in certain fluids those chemical changes termed alcoholic fermentation or putrefaction.

Pasteur fully established the proposition that the different fermentations, such as alcoholic, butyric, acetous, mucous, and lactic fermentations, and also the decomposition of putrescible matter, were caused by definite and different species of such minute living beings, microbes, and that without them such changes did not occur. This proposition implied that these changes were dependent on and ultimately bound up with the life and growth of these microbes, and if these were prevented from gaining access to such fermentative matters, they would remain unchanged or sterile. This was the principle which Sir Joseph Lister had applied in surgery, with the well-known brilliant results. The rôle of these microbes in atmospheric air had been minutely worked out and beautifully illustrated by Professor Tyndall, who shared in finally establishing that with these simple organisms, belonging almost to the world of the infinitely small, the same fundamental principle obtains as in other living organisms of plant and animal life, be they ever so large and complex, namely, that each organism had descended from an antecedent parent organism, and that no such thing as their origin from non-living matter occurred.

Within comparatively recent times it has been shown that a variety of the most important and extensive processes of oxidation and reduction which occur in nature, — such as the oxidation and resolution of dead animal and vegetable matter, the breaking up of complex nitrogenous materials and their ultimate change into nitrites and nitrates, and the specific fermentation so important in foodstuffs and articles of diet, and many other processes, — are caused by and intimately connected with the growth and life of microbes. Though the importance of some species as useful agencies in nature is recognized, the importance of other species, as being the cause of disease affecting plants, animals, and man, is not less. The term micro-parasite is given to this latter group.

Amongst the microbes there is one great group to be dealt with in particular, called "bacteria," because it possesses more or less the shape of a minute rod. Like the true or higher fungi, they are free from chlorophyll, and are composed of cells, a cellular membrane with living matter or protoplasm within, and they multiply by fission, for which reason they are called "fission fungi." Bacteria can then be defined as microscopic elementary organisms, composed of a cellulose investment of the protoplasmic contents, and which multiply by simple fission. They are classified into micrococci or cocci, bacilli, and spiral vibriones, according to whether they are spherical, cylindrical, or curved and spiral.

All these organisms, when they have found suitable nidus, multiply with enormous rapidity. It has, for example, been found from observation — all conditions of moisture, medium, and

temperature being favorable — that some multiply in twenty minutes, others in thirty minutes, and others in forty minutes.

Staphylococcus aureus, which in its growth produces a peculiar golden-colored filament, grows with great rapidity when sown in a medium like faintly alkaline broth at a temperature of 37° C. Into a sterile broth tube a definite number of organisms are put, say eight cocci per cubic centimetre. If placed in an incubator for twenty-four hours at 37° C., and then counted, it is found that 1 cubic centimetre contains 640,000; that is to say, one organism has multiplied eighty thousand-fold in the first twenty-four hours. It would not be expected that the same rate would obtain in the second twenty-four hours, because the material had been used up. After forty-eight hours' growth the counting yielded 248,000,000 per cubic centimetre; that is, only four hundred-fold. In seventy-two hours it was found that there were 1,184,000,000 per cubic centimetre; that is to say, during the last day each had multiplied only five-fold. As the material is used up the rate of multiplication decreases.

Another instance of the rapidity of growth was given. A rabbit was inoculated subcutaneously with 20,000 bacilli of fowl cholera, and died in twenty-four hours. It was found that 15,150,000 microbes were contained in one cubic centimetre of the blood of the animal. The whole of the blood contained twelve hundred millions, showing that each bacillus in twenty-four hours had multiplied sixty thousand times. Those organisms which have their habitat in ordinary temperatures grow very rapidly. Professor Ferdinand Cohn was the first to study the rate of multiplication on the hay bacillus. He calculated that in two days the number of these would be so great that the whole Atlantic Ocean would be densely peopled by them if there was sufficient nutriment, which, fortunately, there is not, and therefore many of them had to go to the wall.

By the motility of bacteria is understood active locomotion. They spin round, they dart to and fro, and pass rapidly over the field of the microscope, and that is on account of their possessing one, two, three, or even a multitude of fine hairs. The organism of typhoid fever possesses several of these *flagellæ*. It has been shown that for retaining this motility a plentiful supply of oxygen is required. If, in a chamber, at one end oxygen is supplied, and at the other nitrogen or hydrogen gas, the organisms will all move towards the end where the oxygen is. If the oxygen is replaced by nitrogen or hydrogen the movement gradually ceases. If water is covered with a scum, it is most probably a motile bacillus which grows in the fluid, and is driven to the surface, where it can derive the best supply of oxygen. In many cases the motility of the organisms is interfered with by their own chemical products.

Within certain of these organisms, but not in all, are formed peculiar corpuscles, which bear the same relation to the organisms as the seed does to the plant. This spore formation is almost entirely limited to the order of bacilli, and in this group there are very many species which do not possess this power. In a number of different species of bacilli, some of which are capable of forming spores and others not; those which have this power may look on very quietly, while those that do not will exhaust all the nutritive material present, growth and multiplication will then cease, and they will gradually die away. Those which form spores have a much better chance of bringing forth new generations than the others.

When organisms do not find suitable materials for their growth, certain changes are brought about called "involution changes." When the bacillus ceases to possess that high degree of vitality that the normal typical bacillus possesses, it gradually undergoes changes which lead to its death. Illustrations were given of what had been described as involution changes, but which were not so. For instance, tubercle bacilli grown under not very favorable conditions may be swollen, and others may appear branched. Some observers took these changes to indicate the death of the organism, but the lecturer was not quite sure that such were "involution changes."

In all these considerations, particularly in reference to the formation of spores, there were a number of facts of very considerable practical importance. The germination of those organisms

which form spores takes place on the same principles as the germination of the spores in the higher fungi. The envelope is broken, the protoplasm contained within it shoots out in the shape of a rod, which when it is fully formed elongates, divides, and multiplies, as in the case of the parent. In this way one bacillus, by repeated multiplication, forms a new crop. When these have reached a certain phase of development they again form spores, which go to start a new generation. These spores have a much greater power of resistance than is possessed by the non-spore-bearing organisms, and can withstand high temperature, dryness, and the influence of light, so much so that it has become almost a recognized method of determining whether a particular species of bacilli forms spores, by subjecting the suspected organism to a temperature of 95° C. or 100° C. If they survive this exposure, and if they survive drying, it may be taken as established that the growth is spore-forming.

HEALTH MATTERS.

The Transmissibility of Hydrophobia from Man to Man.

THE fact that no instance is on record of hydrophobia having been transmitted from man to man has given rise to a doubt as to whether the saliva of human beings suffering from the disease possesses the same virulent properties as that of the dog similarly affected. In not more than five or six of the ten thousand patients treated at the Pasteur Institute was the lesion due to bites inflicted by human beings, and it is evident that statistics bearing on so small a number of cases are of no value one way or the other. It has, however, been proved experimentally, says the *Medical Press*, that the saliva of human beings having succumbed to hydrophobia produces the disease in animals by inoculation, though the incubation period is somewhat prolonged. It may, therefore, be taken as proved that the disease may be transmitted in this way from man to man. It is hardly possible as yet to affirm categorically the possibility of curing hydrophobia after the characteristic symptoms have made their appearance, but recent observations throw a doubt on the incurability of the disease even under these circumstances.

LETTERS TO THE EDITOR.

. Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The Glacial Grooves on Kelley's Island to be Preserved.

THE world of science will rejoice that at last the most remarkable of the glacial grooves on Kelley's Island is to be preserved as an object-lesson to future generations forever.

Many of the citizens of Cleveland will remember that when, in 1888, the American Association for the Advancement of Science met in their city, an excursion was made to Put-in-Bay on the steamer "City of Cleveland," and that, on the way, the boat stopped at the dock of the Kelley's Island Lime and Transport Company, on the north-east corner of the island, to give the men of science an opportunity to see what there was left of the wonderful glacial grooves that have made that locality famous the world over. A few minutes after the palatial steamer touched the dock at the lime-kilns, the hundreds of expectant excursionists might have been seen swarming around and over the great natural wonder they had come to see, and inspecting it from every point of view. They had come, they had seen, and they were conquered. The expressions of astonishment and delight from the eminent scientific men in the company (among whom were numbered Professors Alexander and N. H. Winchell, Professor Cook of New Jersey, Professor Morse of Boston, Major Powell of Washington, Professor Spencer of Canada), as well as from the great number of intelligent amateurs and others present, were of the most extravagant character; and ardent desire was expressed on every hand that measures might be taken for the preservation of the renowned glacial phenomenon, concerning which all felt that the half had